# IBC SEISMIC AND WIND LOAD COMPLIANCE FOR NON-STRUCTURAL COMPONENTS

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# Today's Presenters

Chip Morrow,
Director of Sales,
The VMC Group

Dwight Wells,
MTU Onsite Energy,
Regional Sales Manager,
West

Michael Ivanovich,
Editor-in-Chief &
Moderator, Consulting-
Specifying Engineer

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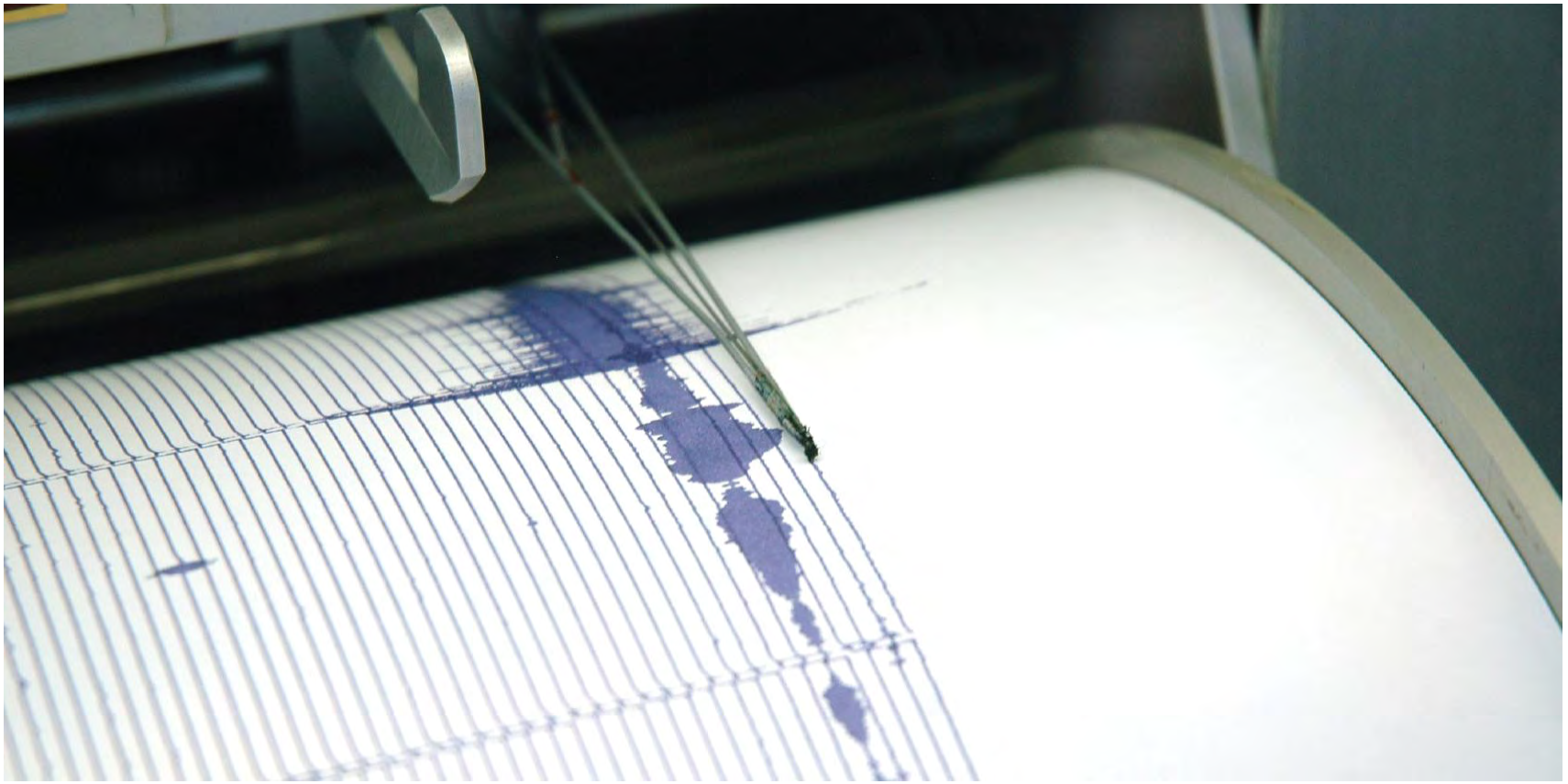
# WELCOME
# IBC SEISMIC LOAD COMPLIANCE FOR NON-STRUCTURAL COMPONENTS

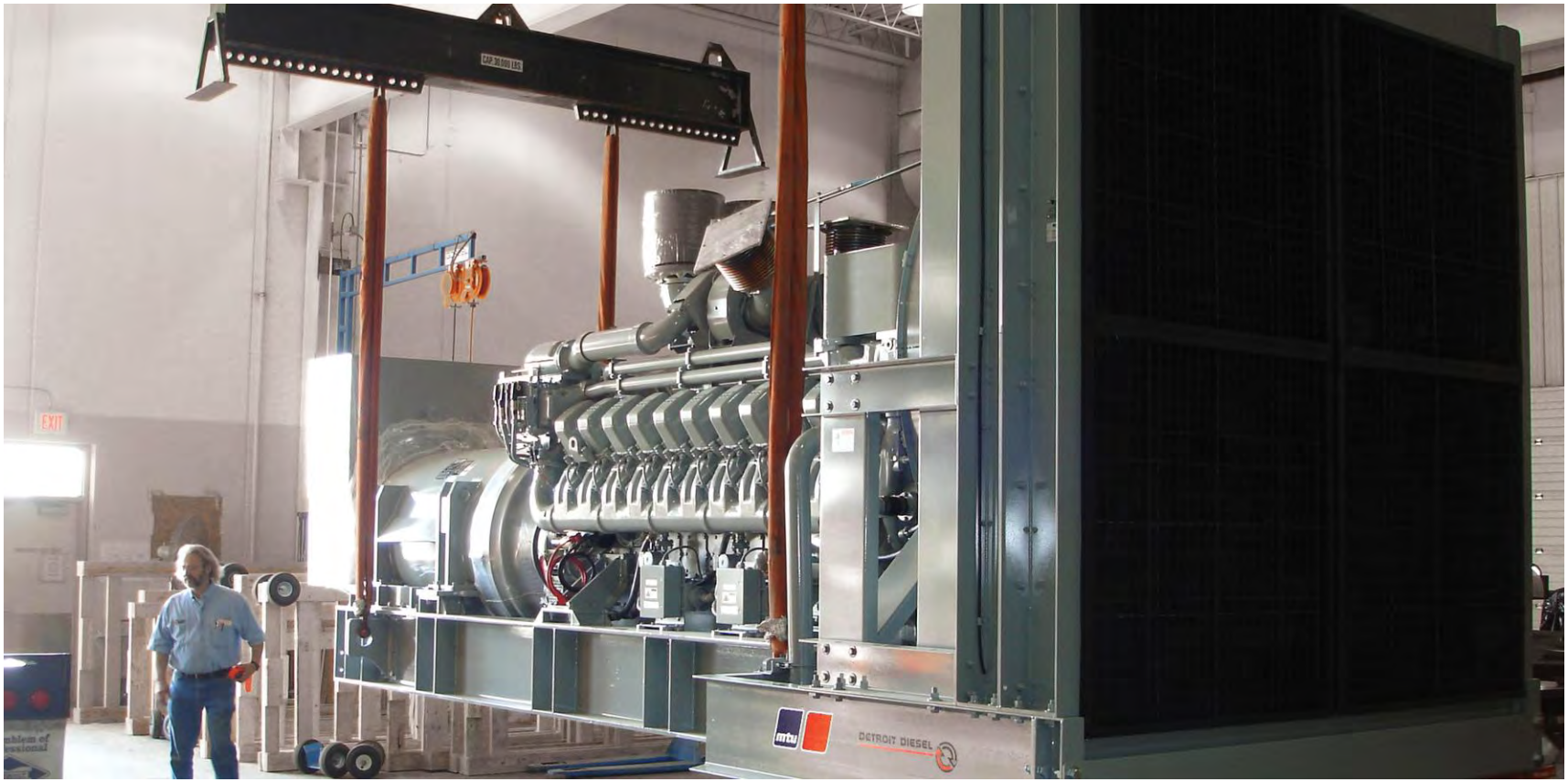
# STANDARDS AFFECT
# GENSET SPECIFICATION



# ADVANCED
# ENGINE DESIGN

# IBC COMPLIANCE
## WHERE REQUIRED

# GENSETS
## UP TO 3,250 KW



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THE VMC GROUP

# IBC SEISMIC AND WIND LOAD COMPLIANCE FOR NON-STRUCTURAL COMPONENTS

## Requirements for
## Occupancy Category IV, IBC 2003 & 2006

Chip Morrow
Director of Sales
The VMC Group

# WHY ARE WE HERE?

- To acquaint you with the seismic/wind load "on line" requirements of the International Building Code (IBC)
- To teach you how to help minimize your exposure to risk and liability

# WHAT IS THE IBC CODE?

- International Building Code (IBC) is a publication developed by the International Code Council (ICC)
- ICC consists of representatives from BOCA, ICBO & SBCCI
- ICC was assembled to develop a single set of national model construction codes
- IBC-2000/2003/2006 publication is funded and supported by NEHRP (National Science Foundation, National Institute and Standards of Technology, FEMA and USGS)
- All states have adopted one version of the code
- Code specifically addresses design and installation of building systems with emphasis on performance

# WHAT IS THE IBC CODE?

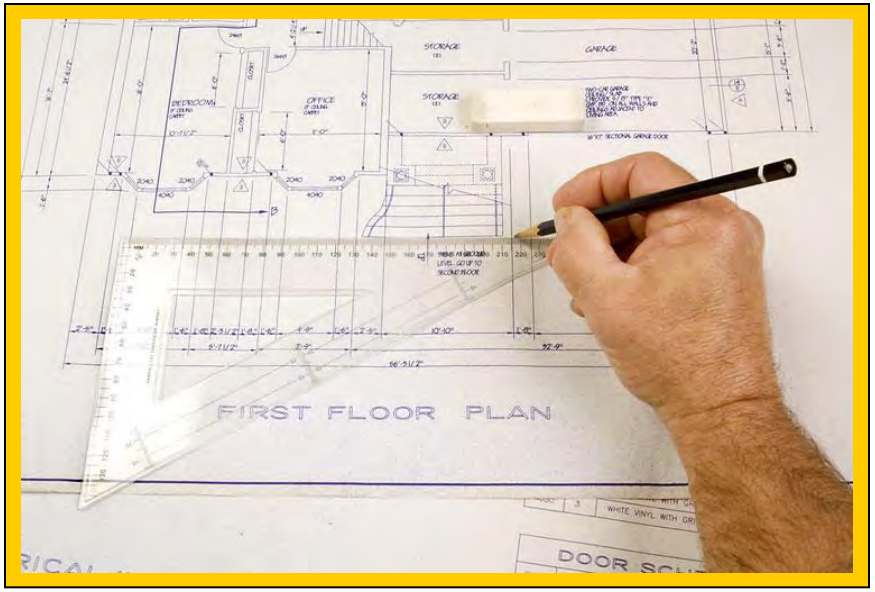
- IBC-2000/2003/2006 specifically addresses the capabilities of a piece of equipment to withstand seismic loads AND now wind loads
- Until now, only the anchorage of a unit to the structure was considered – equipment performance was never properly considered
- For the first time, critical equipment is now considered a component of the structure

# ROLES AND RESPONSIBILITIES

- The role of the architect, structural engineer and equipment specifying engineer.

# ROLES AND RESPONSIBILITIES

- The architect

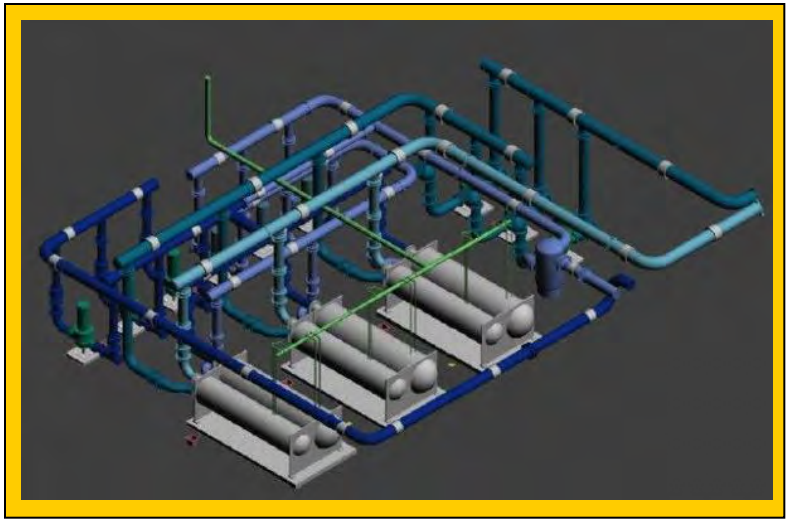


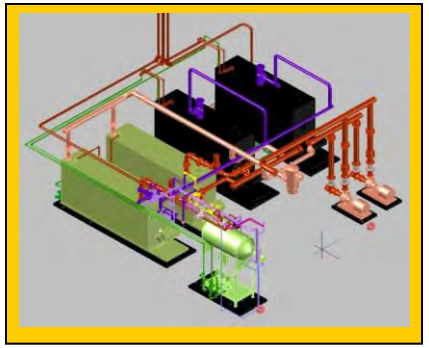
# ROLES AND RESPONSIBILITIES

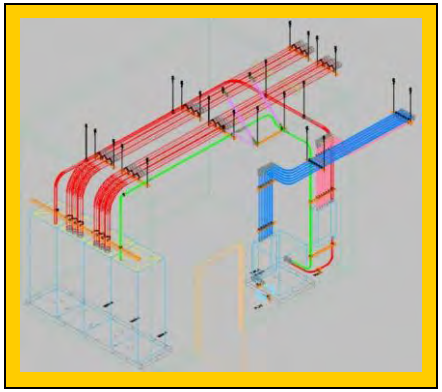
- The structural engineer

# ROLES AND RESPONSIBILITIES

- The equipment specifying engineer







# OCCUPANCY CATEGORY IV BUILDINGS

- At a *minimum*, IBC Certification and installation details are required for the following ***essential facilities***:
  - Hospitals and other healthcare facilities
  - Fire, rescue and police stations
  - Designated earthquake, hurricane or other emergency shelters
  - 911, communication, data, switching, operation – centers
  - Most power-generating stations and other public utility facilities
  - Structures containing highly toxic materials
  - Buildings and structures having critical national defense functions
  - Most water treatment facilities
  - Aviation control towers, air traffic control centers, emergency aircraft hangers and some terminal buildings

# COMPONENT IMPORTANCE FACTOR

## 13.1.3 Component Importance Factor *ASCE 7-05*

**Section 13.1.3- Component Importance Factor.**

All components shall be assigned a component importance factor as indicated in this section. The component importance factor, $I_p$, shall be taken as 1.5 if any of the following conditions apply:

1. The component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems.
2. The component contains hazardous materials.
3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.

All other components shall be assigned a component importance factor, Ip, equal to 1.0.

IBC CODE

# OEM RESPONSIBILITY

**DESIGNATED SEISMIC SYSTEMS:** The seismic force-resisting system and those architectural, electrical, and mechanical systems or their components that require design in accordance with Chapter 13 and for which the component importance factor, $I_p$, is greater than 1.0.

IBC CODE

# OEM RESPONSIBILITY

**1708.5 Seismic qualification of mechanical and electrical equipment.** The registered design professional in responsible charge shall state the applicable seismic qualification requirements for designated seismic systems on the construction documents. Each manufacturer of designated seismic system components shall test or analyze the component and its mounting system or anchorage and submit a certificate of compliance for review and acceptance by the registered design professional in responsible charge of the design of the designated seismic system and for approval by the building official. Qualification shall be by an actual test on a shake table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces, by the use of experience data (i.e., historical data demonstrating acceptable seismic performance) or by a more rigorous analysis providing for equivalent safety.

# INTERRELATIONSHIP CLAUSE

## 13.2.3 Consequential Damage, ASCE 7-05

Consequential Damage- The functional and physical interrelationship of components, their supports, and their effect on each other shall be considered so that the failure of an essential or nonessential architectural, mechanical, or electrical component shall not cause the failure of an essential architectural, mechanical, or electrical component.

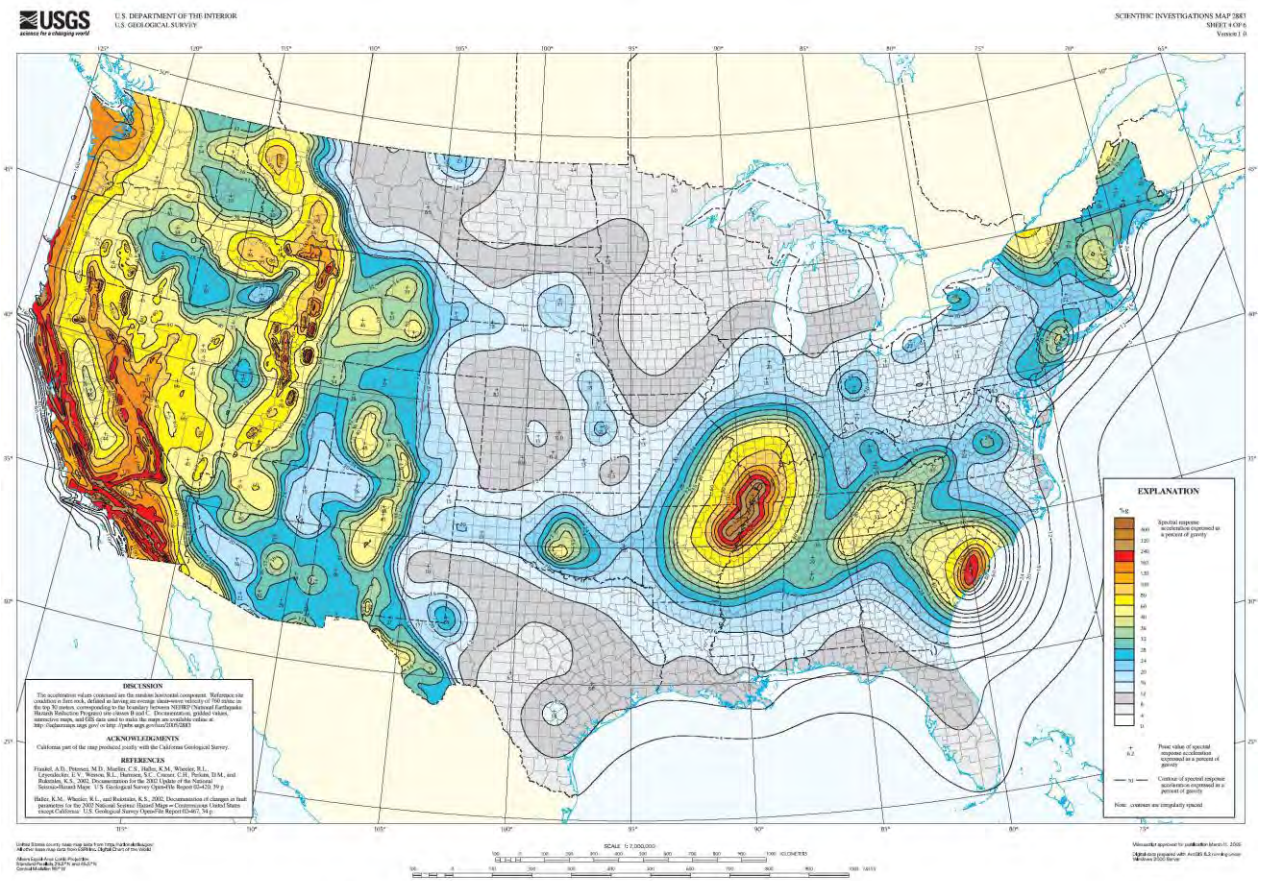
# RESPONSIBILITY

- The IBC clearly provides that it is the responsibility of:
  - Equipment manufacturers
  - Suppliers
  - Installers
  - Design Team Managers
  - Engineers

to insure that their component remains "on line and functional", *after the emergency has occurred!*

CODE REQUIREMENTS

# SHORT PERIOD SPECTRAL RESPONSE




**Horizontal Spectral Response Acceleration for 0.2-Second Period (5 Percent of Critical Damping)**
**With 2 Percent Probability of Exceedance in 50 Years**

**SEISMIC-HAZARD MAPS FOR THE CONTERMINOUS UNITED STATES**

By

Arthur D. Frankel, Mark D. Petersen, Charles S. Mueller, Kathleen M. Haller, Russell L. Wheeler, E.V. Leyendecker, Robert L. Wesson, Stephen C. Harmsen, Chris H. Cramer, David M. Perkins, and Kenneth S. Rukstales

2005

CODE REQUIREMENTS

# RESPONSIBILITY

TABLE 1604.5
OCCUPANCY CATEGORY OF BUILDINGS AND OTHER STRUCTURES

| OCCUPANCY CATEGORY | NATURE OF OCCUPANCY |
|---|---|
| I | Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to:<br>• Agricultural facilities.<br>• Certain temporary facilities.<br>• Minor storage facilities. |
| II | Buildings and other structures except those listed in Occupancy Categories I, III and IV |
| III | Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to:<br>• Covered structures whose primary occupancy is public assembly with an occupant load greater than 300.<br>• Buildings and other structures with elementary school, secondary school or day care facilities with an occupant load greater than 250.<br>• Buildings and other structures with an occupant load greater than 500 for colleges or adult education facilities.<br>• Health care facilities with an occupant load of 50 or more resident patients, but not having surgery or emergency treatment facilities.<br>• Jails and detention facilities.<br>• Any other occupancy with an occupant load greater than 5,000.<br>• Power-generating stations, water treatment for potable water, waste water treatment facilities and other public utility facilities not included in Occupancy Category IV.<br>• Buildings and other structures not included in Occupancy Category IV containing sufficient quantities of toxic or explosive substances to be dangerous to the public if released. |
| IV | Buildings and other structures designated as essential facilities, including but not limited to:<br>• Hospitals and other health care facilities having surgery or emergency treatment facilities.<br>• Fire, rescue and police stations and emergency vehicle garages.<br>• Designated earthquake, hurricane or other emergency shelters.<br>• Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response.<br>• Power-generating stations and other public utility facilities required as emergency backup facilities for Occupancy Category IV structures.<br>• Structures containing highly toxic materials as defined by Section 307 where the quantity of the material exceeds the maximum allowable quantities of Table 307.1.(2).<br>• Aviation control towers, air traffic control centers and emergency aircraft hangars.<br>• Buildings and other structures having critical national defense functions.<br>• Water treatment facilities required to maintain water pressure for fire suppression. |

# RESPONSIBILITY FOR SEISMIC

Listed on the project's structural drawings, under ***design loads,*** the following 3 parameters are "red flags" for when special seismic qualification may be required on a project:

- An $S_{DS}$ of .167 or greater
- Occupancy Category IV (IBC-2003 & 2006)
- Seismic Design Category of C, D, E or F

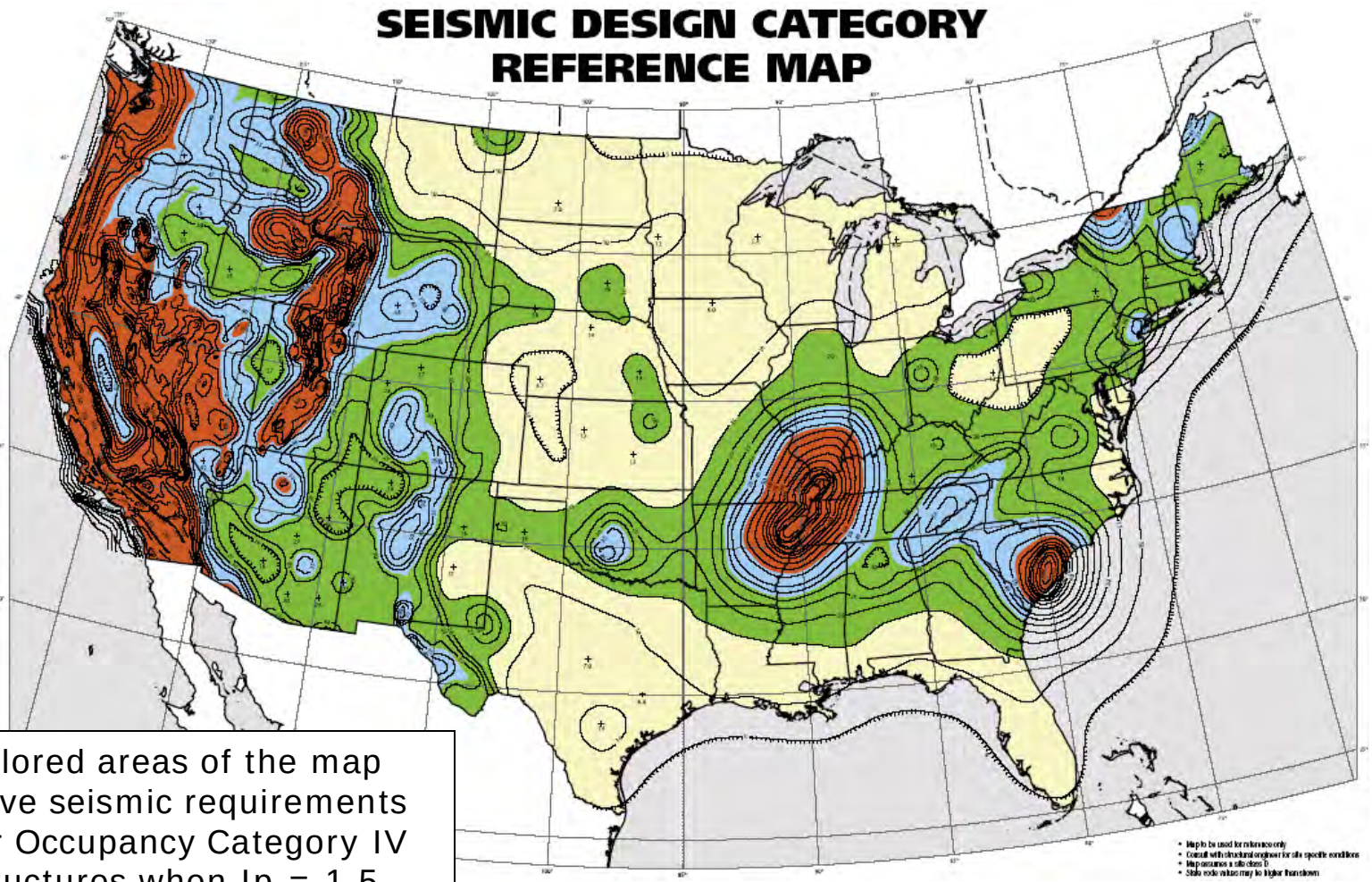
# RESPONSIBILITY

## TABLE 1613.5.6(1)
## SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD RESPONSE ACCELERATIONS

| VALUE OF $S_{DS}$ | OCCUPANCY CATEGORY | | |
|---|---|---|---|
| | I or II | III | IV |
| $S_{DS} < 0.167g$ | A | A | A |
| $0.167g \le S_{DS} < 0.33g$ | B | B | C |
| $0.33g \le S_{DS} < 0.50g$ | C | C | D |
| $0.50g \le S_{DS}$ | D | D | D |

Equipment with an Ip = 1.5 located in buildings given a Seismic Design Category C, D or F (not listed in chart), require certification and proper seismic installation.

# WHEN DO I NEED SEISMIC?

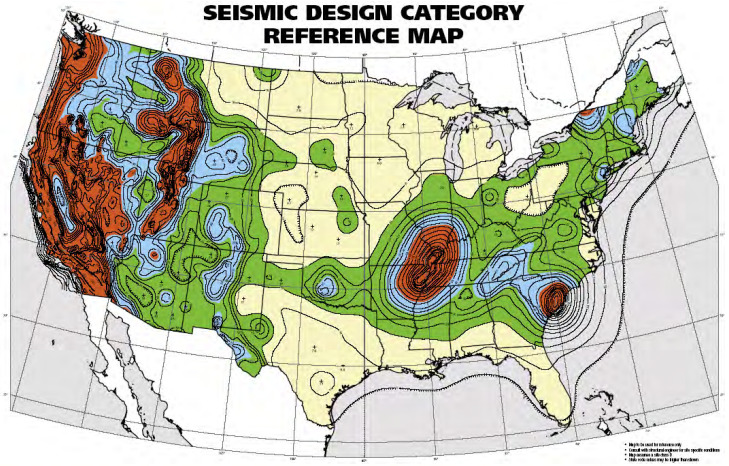



Colored areas of the map have seismic requirements for Occupancy Category IV structures when Ip = 1.5.

# WHEN DO I NEED SEISMIC?

## Seismic Design Category Based on Short-Period Response Accelerations

| Value of $S_{DS}$ | Occupancy Category | | |
|---|---|---|---|
| | I or II | III | IV |
| $S_{DS} < 0.167g$ | A | A | A |
| $0.167g \le S_{DS} < 0.33g$ | B | B | C |
| $0.33g \le S_{DS} < 0.50g$ | C | C | D |
| $0.50g \le S_{DS}$ | D | D | D |



CODE IMPLICATIONS

# STRUCTURAL ENGINEER'S NOTES

DESIGN STANDARD: 2006 INTERNATIONAL BUILDING CODE WITH THE 2006 WASHINGTON STATE AMENDMENTS
OCCUPANCY CATEGORY IV

**DESIGN CRITERIA**

1. DESIGN SNOW LOADS FOR NEW CONSTRUCTION, UNLESS NOTED OTHERWISE:
   ROOF..... 20 PSF MINIMUM ROOF SNOW LOAD
   SNOW BUILD-UP:..... ASCE 7 $I_S = 1.2$
2. DESIGN LATERAL LOADS FOR NEW CONSTRUCTION, UNLESS NOTED OTHERWISE:
   A. WIND: ASCE 7 85 MPH EXPOSURE B $I_W = 1.15$
   B. SEISMIC:
   INTERNATIONAL BUILDING CODE SEISMIC DESIGN CATEGORY D
   SOIL CLASSIFICATION: E
   $R = 6$ $I_E = 1.5$
   $S_{DI} = 0.30$ $S_{DS} = 0.54$

This is NOT the same as the Equipment Importance Factor (Ip)

# REQUIREMENTS FOR EQUIPMENT

For those components with an $I_p = 1.5$

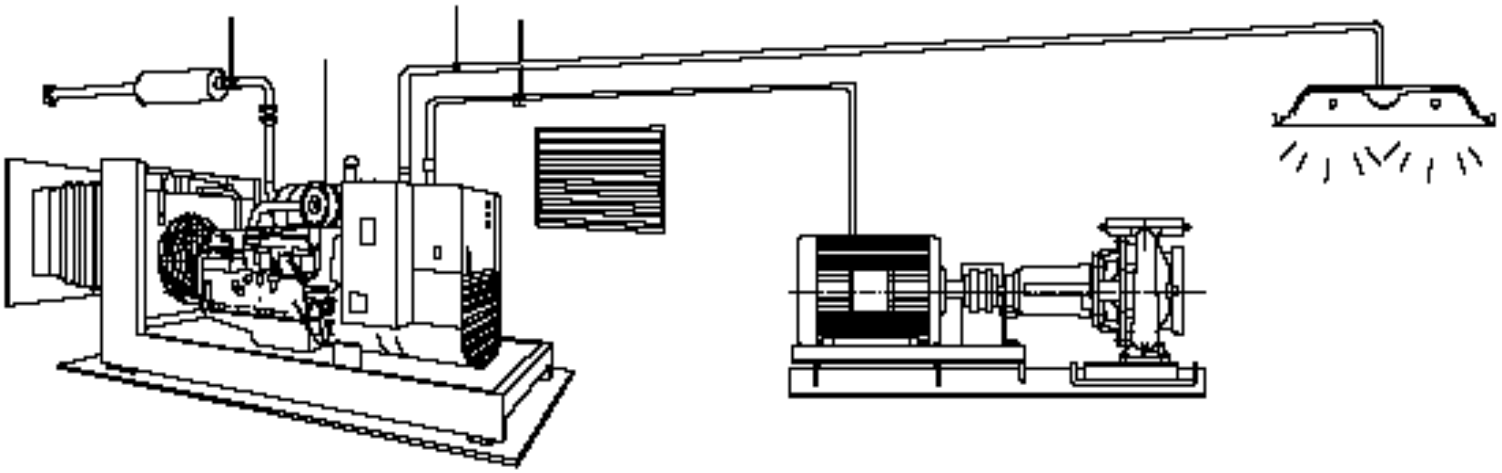
- Certification of Compliance for the equipment is required
- Labeling of equipment is required
- Proper seismic installation is required
- Special Inspections may be required

# MANUFACTURERS

## Emergency Equipment

- Every manufacturer providing a component (equipment) that embraces the term "**emergency**" ($I_p$ = 1.5), must now *warrant* and *guarantee* through specified *outside testing* that their component will *start* and *continue to run* after being subjected to the specified seismic forces

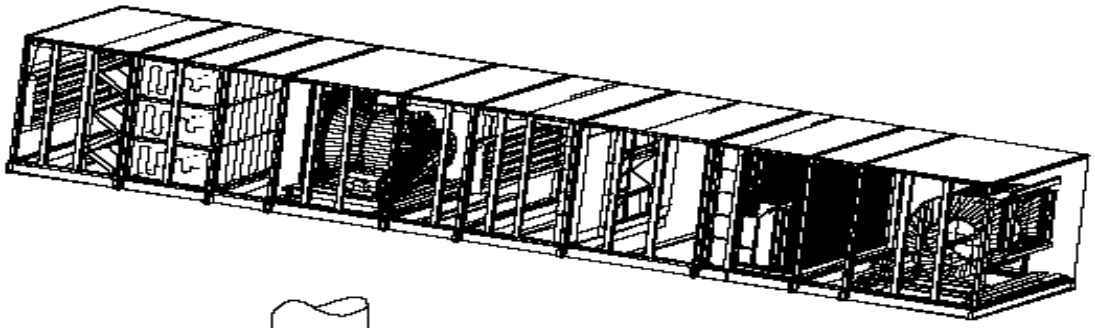
# EMERGENCY GENERATION POWER



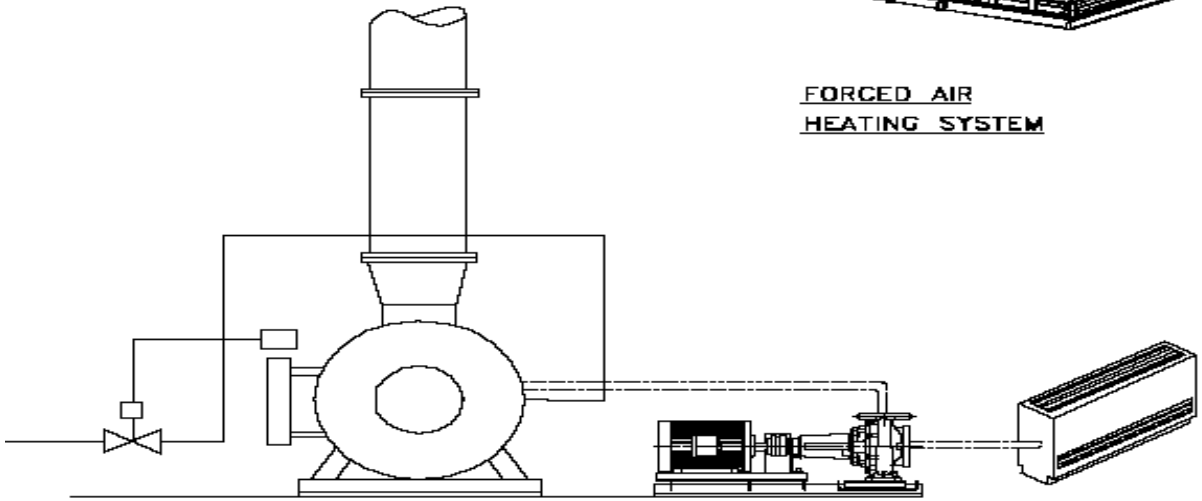
EMERGENCY POWER GENERATION

**Life Safety, Ip = 1.5**

# HEATING SYSTEM



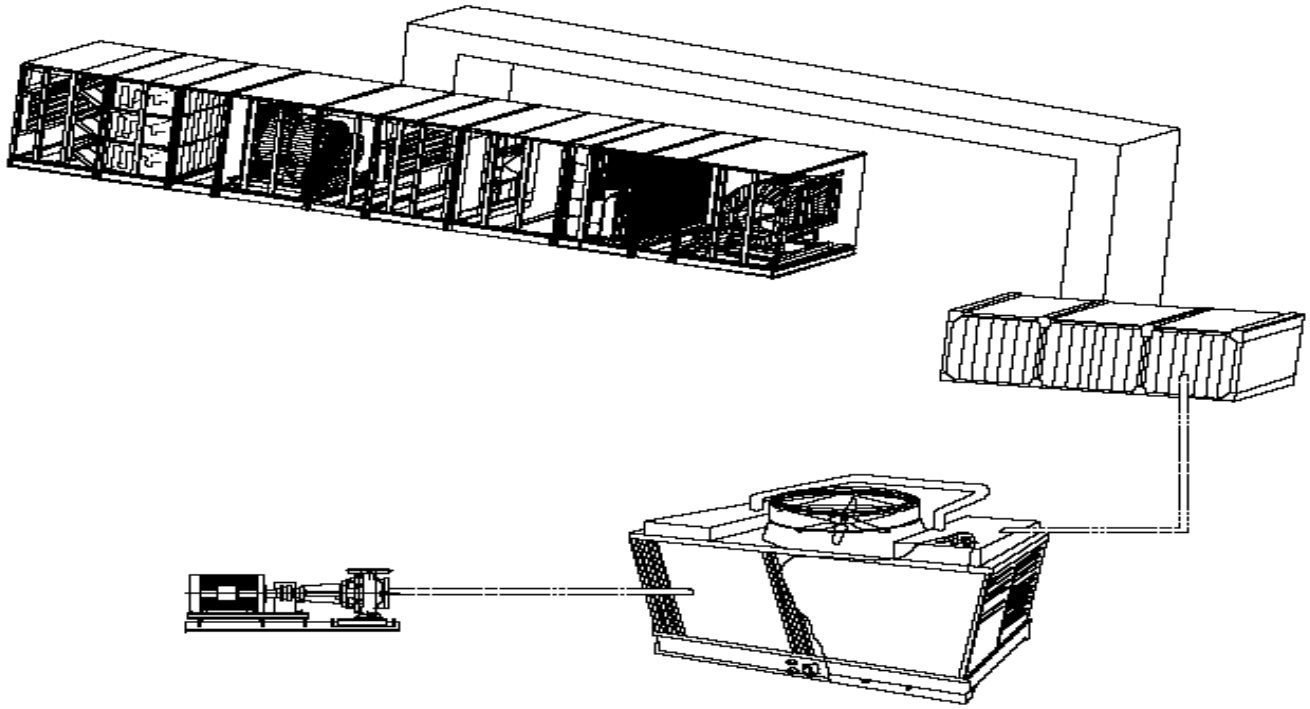
FORCED AIR
HEATING SYSTEM



HYDRONIC
HEATING SYSTEM

Life Safety Ip 1.5

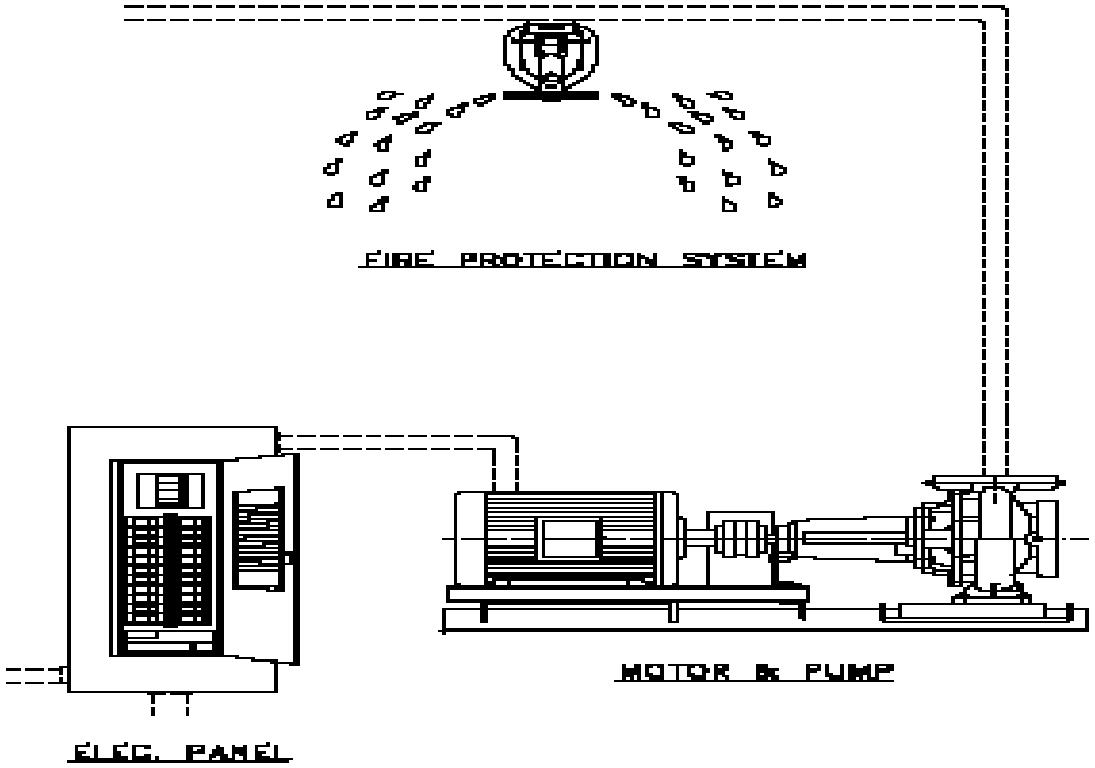
# AIR CONDITIONING SYSTEM



HYDRONIC
AIR CONDITIONING SYSTEM

**Life Safety Ip 1.5**

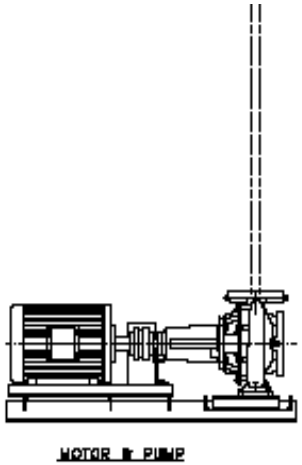
# FIRE PROTECTION

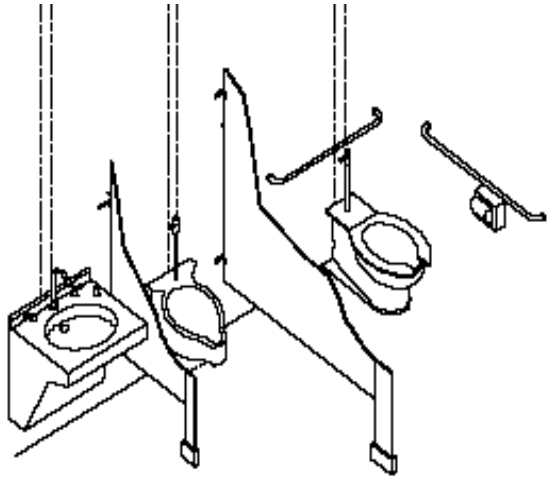



FIRE PROTECTION

**Life Safety, Ip = 1.5**

# SANITARY & POTABLE WATER SYSTEMS



SANITARY & POTABLE WATER SYSTEM

**Life Safety Ip 1.5**

# ON LINE AND FUNCTIONAL

How does a manufacturer prove "On Line and Functional?"

- IBC Chapter 17, under Structural Tests and Special Inspections defines the "how"

By an:

- Approved Agency/ Special Inspector
- Certificate of Compliance
- Inspection Certificate
- Labeling of equipment

C OF C

# ON LINE AND FUNCTIONAL

## SEISMIC CERTIFICATE OF COMPLIANCE

The following MTU Onsite Energy generator sets are seismically certified[1] in accordance with the IBC – 2000, IBC – 2003 and IBC – 2006[2] International Building Codes:

| Unit Size | Engine Family |
|---|---|
| 650 kW | 12V2000G43 |
| 750 kW | 12V2000G83 |
| 900 kW | 16V2000G83 |
| 1000 kW | 16V2000G83 |
| 1150 kW | 16V2000 |
| 1250 kW | 12V4000G45 |
| 1500 kW | 12V4000G53 |
| 1750 kW | 12V4000G83 |
| 2000 kW | 16V4000G43 |
| 2250 kW | 16V4000G83 |
| 2500 kW | 20V4000G43 |
| 2850 kW | 20V4000G83 |
| 3000 kW | 20V4000G83L |
| 3250 kW | 20V4000G83L |

Mathematical modeling and shake table testing of component samples were conducted in accordance with ASCE 7-98, ASCE 7-02 and ASCE 7-05 as referenced in the International Building Code. Where applicable, tri-axial shake table testing was conducted in accordance with AC156 at nationally recognized Clark Dynamic Test Laboratory and analytically evaluated by the independent approval agency, The VMC Group.[3]

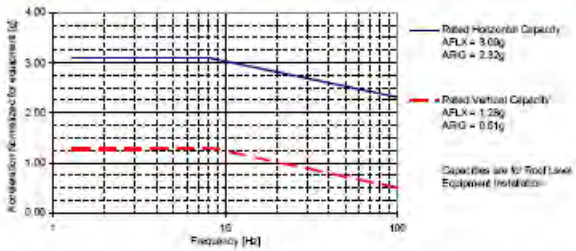
The above referenced equipment is APPROVED for seismic applications when properly installed[4], used as intended, and located in the United States. Below grade, grade, and roof-level installations are permitted and included in this approval. Installations in essential facilities and as life safety applications - both requiring post event functionality, are also included in this approval. Application boundaries are as follows:

Parameters, IBC 2006:

Roof-top installations (z/h = 1) permitted when:
$S_{ds} \leq 0.55$, $I_p = 1.5$, $a_p = 2.5$, $R_p = 2.0$

Below grade and at grade (z/h = 0) installations permitted when:
$S_{ds} \leq 1.93$, $I_p = 1.5$, $a_p = 2.5$, $R_p = 2.0$

Seismic shake table test levels enveloped a response spectrum with a ZPA of 2.32g and an amplified region acceleration of 3.09g. This level corresponds to an $S_{ds}$ value of 1.93g (290%g $S_s$ for Soil Class D and lower).[5]




## CERTIFICATE OF COMPLIANCE NOTES

1. All equipment listed herein successfully passed the seismic acceptance criteria for non-structural components and systems as set forth in the various versions of the International Building Codes. For those components shake table tested in accordance with AC156, each unit remained captive and operational after the seismic shake-table event. Components mathematically modeled, successfully passed the design criteria as required by the American Society of Civil Engineers Standard 7.

2. The following building codes are addressed under this certification:

   IBC 2000 – referencing ASCE 7-98 and ICC AC-156
   IBC 2003 – referencing ASCE 7-02 and ICC AC-156
   IBC 2006 – referencing ASCE 7-05 and ICC AC-156

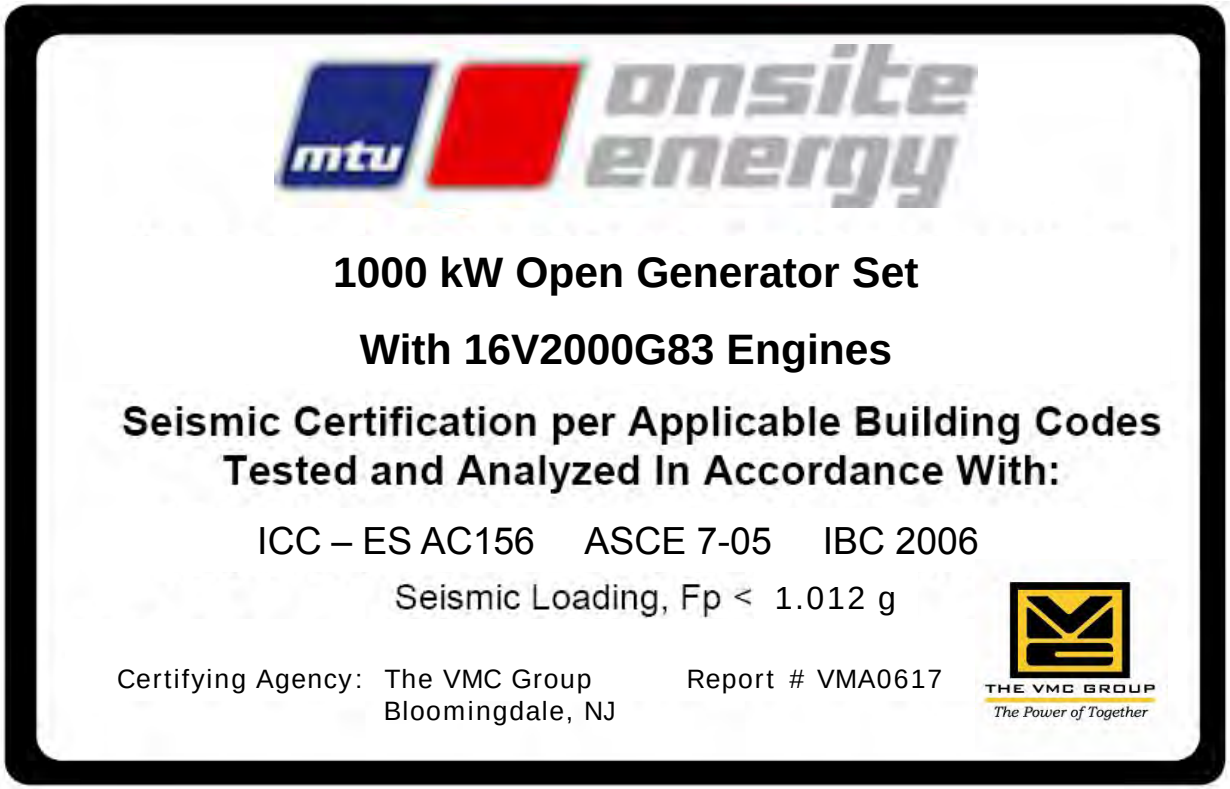
3. Seismic structural analysis was performed by finite element methods and calculations using principles from the ASCE/SEI Standard 7-05 Minimum Design Loads for Building Structures, AISC Manual of Steel Construction Allowable Stress Design (Ninth Edition), published design and analysis methods, and experimental data as permitted in the IBC. Seismic qualification testing was conducted on a tri-axis shake table. The test response spectrum exceeded the design response spectrum as defined in the American Society of Civil Engineers documents ASCE 7-98, ASCE 7-02 and ASCE 7-05 as well as acceptable testing references defined in the IBC 2000, 2003 and 2006. The test response spectrum (TRS) enveloped the design response spectrum (DRS) as shown on previous page.

4. Refer to MTU Onsite Energy product drawings for anchor requirements and mounting considerations. Anchor locations, size, type, and load requirement guidelines are specified on the drawings provided by MTU. Mounting requirement details such as brand, type, embedment depth, edge spacing, anchor spacing, concrete strength, wall bracing, and special inspection must be outlined and approved by the installation project Structural Engineer of Record. Structural walls, structural floors, and housekeeping pads must also be seismically designed and approved, by the installation project Structural Engineer of Record, to accommodate the anchor selections as defined on MTU installation drawings. The installing contractor is responsible for the proper installation of all anchors and mounting hardware, observing the mounting requirement details outlined by the Engineer of Record. Contact your MTU Representative if a detailed Seismic Installation Calculation Package is required.

5. This certification is based on a maximum $S_{ds}$ value of 1.93 g. This is obtained from the Maximum Considered Earthquake Short Period Spectral Response Acceleration, $S_s$, of 290% g for Soil Site Class B with 5% damping. When the site soil properties or final equipment installation location are not known, the soil site coefficient, $F_a$, defaults to the Soil Site Class D coefficient. Soil Classes A, B, C, D, E, Seismic Use groups I, II, III, IV, and Seismic Design Categories A, B, C, D, E, and F are all covered under this certification, limited by the $S_{ds}$ value stated above. A seismic importance factor, $I_p$, of 1.5 applies to this certification to include essential facility requirements and life safety applications for post event functionality.

LABELLING

# ON LINE AND FUNCTIONAL



IBC CODE

# OEM RESPONSIBILITY

**1708.5 Seismic qualification of mechanical and electrical equipment.** The registered design professional in responsible charge shall state the applicable seismic qualification requirements for designated seismic systems on the construction documents. Each manufacturer of designated seismic system components shall test or analyze the component and its mounting system or anchorage and submit a certificate of compliance for review and acceptance by the registered design professional in responsible charge of the design of the designated seismic system and for approval by the building official. Qualification shall be by an actual test on a shake table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces, by the use of experience data (i.e., historical data demonstrating acceptable seismic performance) or by a more rigorous analysis providing for equivalent safety.

IBC CODE

# OEM RESPONSIBILITY

IBC CODE

# OEM RESPONSIBILITY

| REV. | DESCRIPTION | SOURCE of CHANGE | DATE |
|---|---|---|---|
| 0 | Initial Submittal | | 5/29/08 |
| 1 | Revised Anchor size per customer's request | | 11/17/08 |

## SEISMIC RESTRAINT & VIBRATION ISOLATION SUBMITTAL

Customer: MTU Onsite Energy

**Job: Kaiser Permanente**

**Location: Los Angeles, CA**

**The following report has been performed for compliance with the applicable building codes and job specifications.**

**Applicable Building Code:** **IBC 2006, CBC 2007**

**Including Drawings:**
**VMA-44472 - pg. 1 to 14**
**& VMA-44472 - A, B**

ROBERT EDWARD SIMMONS STATE OF WASHINGTON 35963 REGISTERED PROFESSIONAL ENGINEER
11-18-08
EXPIRES: 4/20/10
This report reflects information received and reviewed for seismic restraint as of date shown

The VMC Group
113 Main Street
Bloomingdale NJ, 07403

THE VMC GROUP
The Power of Together™

| CAGE CODE | SIZE | DWG NO | REV |
|---|---|---|---|
| 4U931 | | VMA-44472 | 1 |
| BY | DATE | SO NO. | SHEET |
| DVS | 11/17/2008 | | 2 of 14 |

| PROJECT | JOB / DWG NUMBER | REV. NO. | SHEET NO. |
|---|---|---|---|
| | VMA-44472 | 1 | 9 of 14 |
| CUSTOMER | BY / DATE | CHECKED / DATE | |
| | DVS 11/17/2008 | RS 8-04-08 | |

VIII. SEISMIC INPUT FORCES:

The building is a Seismic Use Group III  Ss = 0.48
Site class = C  Therefore use Seismic Design Category D

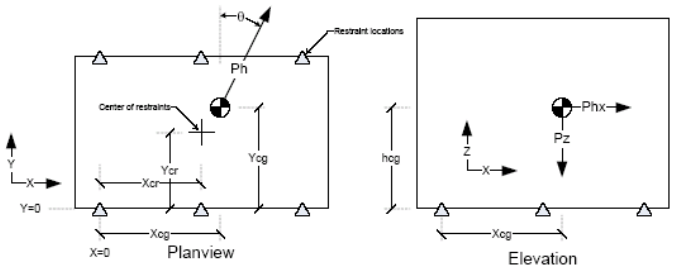
From the appropriate tables:  Fa = **1.20**  Sds = **0.383**

| For: | ap = 2.5, Rp = 1.5, Ip = 1.5 | | ap = 1.0, Rp = 2.5, Ip = 1.5 | | ap = 2.5, Rp = 2.5, Ip = 1 | | ap = 1.0, Rp = 2.5, Ip = 1 | |
|---|---|---|---|---|---|---|---|---|
| At: | z/h = | Fp = | z/h = | Fp = | z/h = | Fp = | z/h = | Fp = |
| | 0.0 | 0.38 g's | 0.0 | 0.09 g's | 0.0 | 0.15 g's | 0.0 | 0.06 g's |
| | 0.2 | 0.54 g's | 0.2 | 0.13 g's | 0.2 | 0.21 g's | 0.2 | 0.09 g's |
| | 0.4 | 0.69 g's | 0.4 | 0.17 g's | 0.4 | 0.28 g's | 0.4 | 0.11 g's |
| | 0.6 | 0.84 g's | 0.6 | 0.20 g's | 0.6 | 0.34 g's | 0.6 | 0.13 g's |
| | 0.8 | 1.00 g's | 0.8 | 0.24 g's | 0.8 | 0.40 g's | 0.8 | 0.16 g's |
| | 1.0 | 1.15 g's | 1.0 | 0.28 g's | 1.0 | 0.46 g's | 1.0 | 0.18 g's |

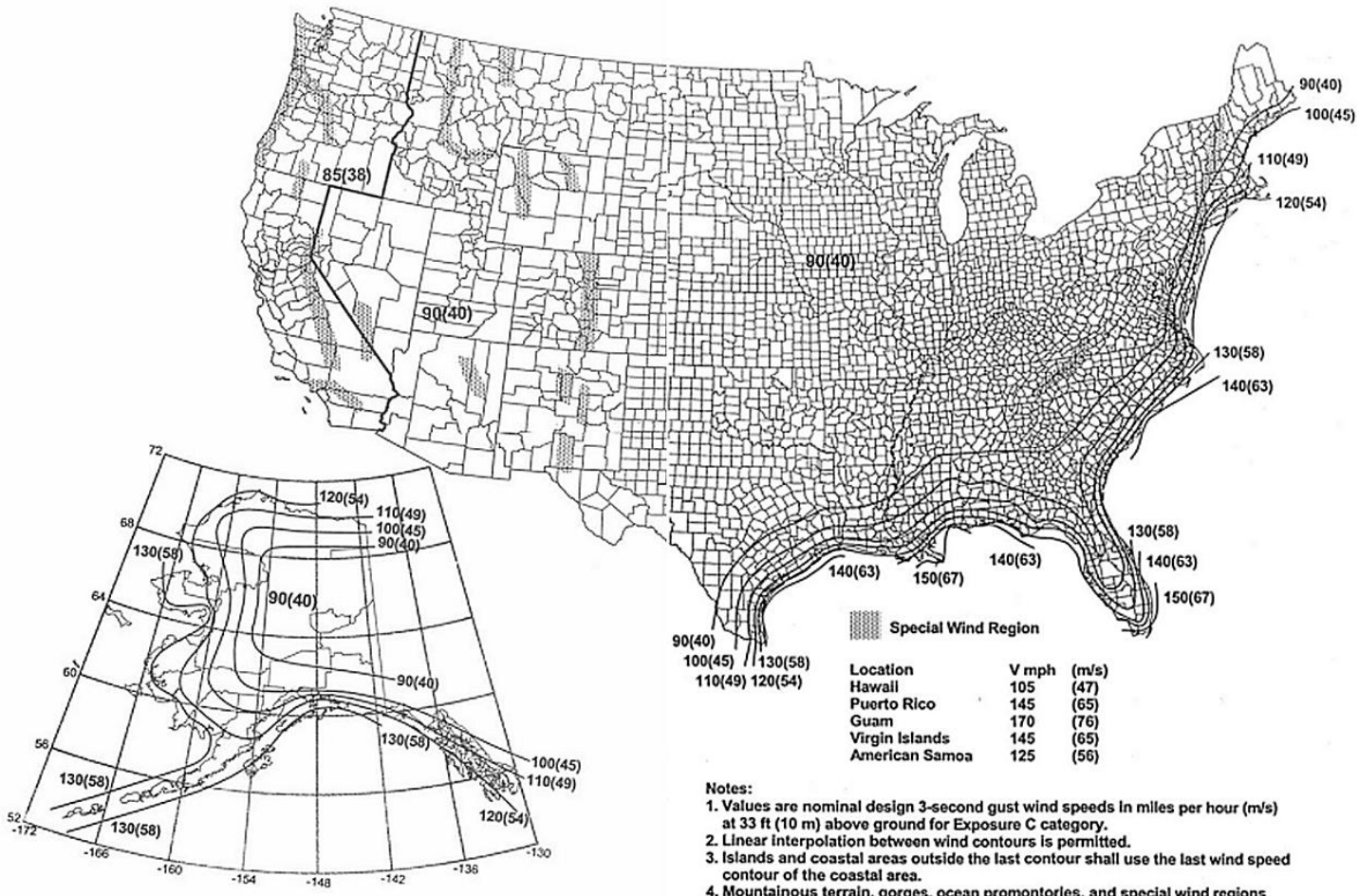
Satisfying the upper and lower bounds:  At Ip = 1.5, Fp Min = 0.172 g's  At Ip = 1, Fp Min = 0.115 g's
0.3*Sds*Ip*Wp < Fp < 1.6*Sds*Ip*Wp  At Ip = 1.5, Fp Max = 0.92 g's  At Ip = 1, Fp Max = 0.613 g's

Table 2

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Condition 1 | At z/h = | Ph | Pz | Ph | Pz | Ph | Pz | Ph | Pz |
| | 0.0 | 0.27 g's | 1.05 g's | 0.12 g's | 1.05 g's | 0.11 g's | 1.05 g's | 0.08 g's | 1.05 g's |
| | 0.2 | 0.38 g's | 1.05 g's | 0.12 g's | 1.05 g's | 0.15 g's | 1.05 g's | 0.08 g's | 1.05 g's |
| | 0.4 | 0.48 g's | 1.05 g's | 0.12 g's | 1.05 g's | 0.19 g's | 1.05 g's | 0.08 g's | 1.05 g's |
| | 0.6 | 0.59 g's | 1.05 g's | 0.14 g's | 1.05 g's | 0.24 g's | 1.05 g's | 0.09 g's | 1.05 g's |
| | 0.8 | 0.64 g's | 1.05 g's | 0.17 g's | 1.05 g's | 0.28 g's | 1.05 g's | 0.11 g's | 1.05 g's |
| | 1.0 | 0.64 g's | 1.05 g's | 0.19 g's | 1.05 g's | 0.32 g's | 1.05 g's | 0.13 g's | 1.05 g's |
| Condition 2 | 0.0 | 0.27 g's | 0.55 g's | 0.12 g's | 0.55 g's | 0.11 g's | 0.55 g's | 0.08 g's | 0.55 g's |
| | 0.2 | 0.38 g's | 0.55 g's | 0.12 g's | 0.55 g's | 0.15 g's | 0.55 g's | 0.08 g's | 0.55 g's |
| | 0.4 | 0.48 g's | 0.55 g's | 0.12 g's | 0.55 g's | 0.19 g's | 0.55 g's | 0.08 g's | 0.55 g's |
| | 0.6 | 0.59 g's | 0.55 g's | 0.14 g's | 0.55 g's | 0.24 g's | 0.55 g's | 0.09 g's | 0.55 g's |
| | 0.8 | 0.64 g's | 0.55 g's | 0.17 g's | 0.55 g's | 0.28 g's | 0.55 g's | 0.11 g's | 0.55 g's |
| | 1.0 | 0.64 g's | 0.55 g's | 0.19 g's | 0.55 g's | 0.32 g's | 0.55 g's | 0.13 g's | 0.55 g's |



# 3 SECOND WIND GUST SPEEDS




| Location | V mph | (m/s) |
|---|---|---|
| Hawaii | 105 | (47) |
| Puerto Rico | 145 | (65) |
| Guam | 170 | (76) |
| Virgin Islands | 145 | (65) |
| American Samoa | 125 | (56) |

Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

# WIND DESIGN

## WIND

Applicable for ***all construction*** from shopping malls to hospitals in all areas of the United states, ***no exclusions!***

# WIND DESIGN

**6.5.15.1 Rooftop Structures and Equipment for Buildings with $h \leq 60$ ft (18.3 m).** The force on rooftop structures and equipment with $A_f$ less than $(0.1Bh)$ located on buildings with $h \leq 60$ ft (18.3 m) shall be determined from Eq. 6-28, increased by a factor of 1.9. The factor shall be permitted to be reduced linearly from 1.9 to 1.0 as the value of $A_f$ is increased from $(0.1Bh)$ to $(Bh)$.

REQUIREMENTS

# ROOFTOP WIND DESIGN CALCULATIONS

**Wind Analysis on Roof top equipment**

Below is calculates the wind load on a piece of equipment based on section 6.5.15 in ASCE 7-05 equation (6-28)

| | | | |
|---|---|---|---|
| *Force on roof top unit* | F=qz*G*Cf*Af*area factor | | *(6-28) ASCE 7-05* |
| *Velocity Pressure* | qz=.00256*Kz*Kzt*Kd*V2*I | | *(6-15) ASCE 7-05* |
| | I | 1.15 | |
| | V | 110 | |
| | Kz | 0.98 | *Table 6.3* |
| | Kd | 0.85 | *For Components and cladding* |
| | Kzt | 1 | |
| | qz= | 29.6734592 | |
| *Gust Factor* | G=.925(1+1.7gQ*Iz*Q/(1+1.7*gv*Iz)) | | *(6-4) ASCE 7-05* |
| | Lz=c(33/ž)^(1/6) | | |
| | c= | 0.2 | *Table 6.2* |
| | ž= | 18 | |
| | gQ | 3.4 | *per 6.5.8.1 ASCE 7-05* |
| | gv | 3.4 | *per 6.5.8.1 ASCE 7-05* |
| | Q=SQRT(1/(1+.63((B+h)/Lz)^.63 | | *(6-6) ASCE 7-05* |
| | Lz= L(ž/33)^Є | | *(6-7) ASCE 7-05* |
| | L | 500 | *table 6-2* |
| | Є | 0.2 | *table 6-2* |
| | Lz | 442.9 | |
| | Q= | 0.88 | |
| | G= | 0.814134519 | |
| *Force Coefficient* | Cf= | 1.367 | *Table 6.21* |
| | h/d= | 5 | |
| *Unit Area* | Af= | 24 | |
| *Area factor* | Area factor= | 1.792 | |
| *Force on roof top unit in pounds* | F= | 1419.96 | |
| *Force on roof top unit in G's* | g's= | 1.420 | |

**Input Data**

| | |
|---|---|
| Equipment weight | 1000 |
| Roof Height (ft) | 30 |
| Bulding Length (ft) | 100 |
| Unit area (ft^2) | 24 |
| unit length (ft) | 6 |
| Basic wind Speed | 110 |
| Wind Importance | 1.15 |
| Exposure | C |
| Unit height (ft) | 4 |

# SPECIAL INSPECTION REQUIREMENTS

## SECTION 1704
## SPECIAL INSPECTIONS

**1704.1 General.** Where application is made for construction as described in this section, the owner or the registered design professional in responsible charge acting as the owner's agent shall employ one or more special inspectors to provide inspections during construction on the types of work listed under Section 1704. The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the building official, for inspection of the particular type of construction or operation requiring special inspection. These inspections are in addition to the inspections specified in Section 109.

# QUALITY ASSURANCE REQUIREMENTS

## SECTION 1705
## STATEMENT OF SPECIAL INSPECTIONS

**1705.1 General.** Where special inspection or testing is required by Section 1704, 1707 or 1708, the registered design professional in responsible charge shall prepare a statement of special inspections in accordance with Section 1705 for submittal by the permit applicant (see Section 1704.1.1).

**1705.2 Content of statement of special inspections.** The statement of special inspections shall identify the following:

1. The materials, systems, components and work required to have special inspection or testing by the building official or by the registered design professional responsible for each portion of the work.
2. The type and extent of each special inspection.
3. The type and extent of each test.
4. Additional requirements for special inspection or testing for seismic or wind resistance as specified in Section 1705.3, 1705.4, 1707 or 1708.
5. For each type of special inspection, identification as to whether it will be continuous special inspection or periodic special inspection.

# QUALITY ASSURANCE REQUIREMENTS

**1705.3 Seismic resistance.** The statement of special inspections shall include seismic requirements for the following cases:

1. The seismic-force-resisting systems in structures assigned to Seismic Design Category C, D, E or F in accordance with Section 1613.
2. Designated seismic systems in structures assigned to Seismic Design Category D, E or F.
3. The following additional systems and components in structures assigned to Seismic Design Category C:
    - 3.1. Heating, ventilating and air-conditioning (HVAC) ductwork containing hazardous materials and anchorage of such ductwork.
    - 3.2. Piping systems and mechanical units containing flammable, combustible or highly toxic materials.
    - 3.3. Anchorage of electrical equipment used for emergency or standby power systems.
4. The following additional systems and components in structures assigned to Seismic Design Category D:
    - 4.1. Systems required for Seismic Design Category C.
    - 4.2. Exterior wall panels and their anchorage.
    - 4.3. Suspended ceiling systems and their anchorage.
    - 4.4. Access floors and their anchorage.
    - 4.5. Steel storage racks and their anchorage, where the importance factor is equal to 1.5 in accordance with Section 15.5.3 of ASCE 7.
5. The following additional systems and components in structures assigned to Seismic Design Category E or F:
    - 5.1. Systems required for Seismic Design Categories C and D.
    - 5.2. Electrical equipment.

# QUALITY ASSURANCE REQUIREMENTS

**1707.8 Mechanical and electrical components.** Special inspection for mechanical and electrical equipment shall be as follows:

1. Periodic special inspection is required during the anchorage of electrical equipment for emergency or standby power systems in structures assigned to Seismic Design Category C, D, E or F;
2. Periodic special inspection is required during the installation of anchorage of other electrical equipment in structures assigned to Seismic Design Category E or F;
3. Periodic special inspection is required during installation of piping systems intended to carry flammable, combustible or highly toxic contents and their associated mechanical units in structures assigned to Seismic Design Category C, D, E or F;

**1707.9 Designated seismic system verifications.** The special inspector shall examine designated seismic systems requiring seismic qualification in accordance with Section 1708.5 and verify that the label, anchorage or mounting conforms to the certificate of compliance.

# CONTRACTOR RESPONSIBILITY

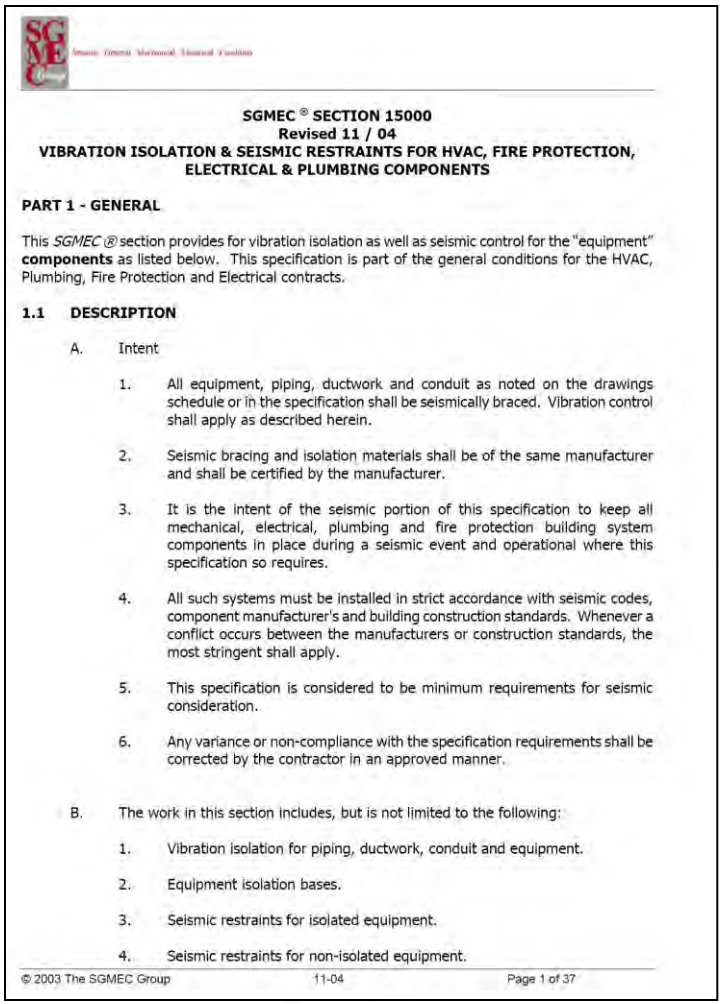
## SECTION 1706
## CONTRACTOR RESPONSIBILITY

**1706.1 Contractor responsibility.** Each contractor responsible for the construction of a main wind- or seismic-force-resisting system, designated seismic system or a wind- or seismic-resisting component listed in the statement of special inspections shall submit a written statement of responsibility to the building official and the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:

1. Acknowledgment of awareness of the special requirements contained in the statement of special inspections;
2. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official;
3. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports; and
4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.

REQUIREMENTS

# SGMEC PROJECT MANAGEMENT PLAN



**SGMEC ® SECTION 15000**
**Revised 11 / 04**
**VIBRATION ISOLATION & SEISMIC RESTRAINTS FOR HVAC, FIRE PROTECTION, ELECTRICAL & PLUMBING COMPONENTS**

**PART 1 - GENERAL**

This *SGMEC ®* section provides for vibration isolation as well as seismic control for the "equipment" **components** as listed below. This specification is part of the general conditions for the HVAC, Plumbing, Fire Protection and Electrical contracts.

**1.1 DESCRIPTION**

A. Intent

1. All equipment, piping, ductwork and conduit as noted on the drawings schedule or in the specification shall be seismically braced. Vibration control shall apply as described herein.
2. Seismic bracing and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
3. It is the intent of the seismic portion of this specification to keep all mechanical, electrical, plumbing and fire protection building system components in place during a seismic event and operational where this specification so requires.
4. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
5. This specification is considered to be minimum requirements for seismic consideration.
6. Any variance or non-compliance with the specification requirements shall be corrected by the contractor in an approved manner.

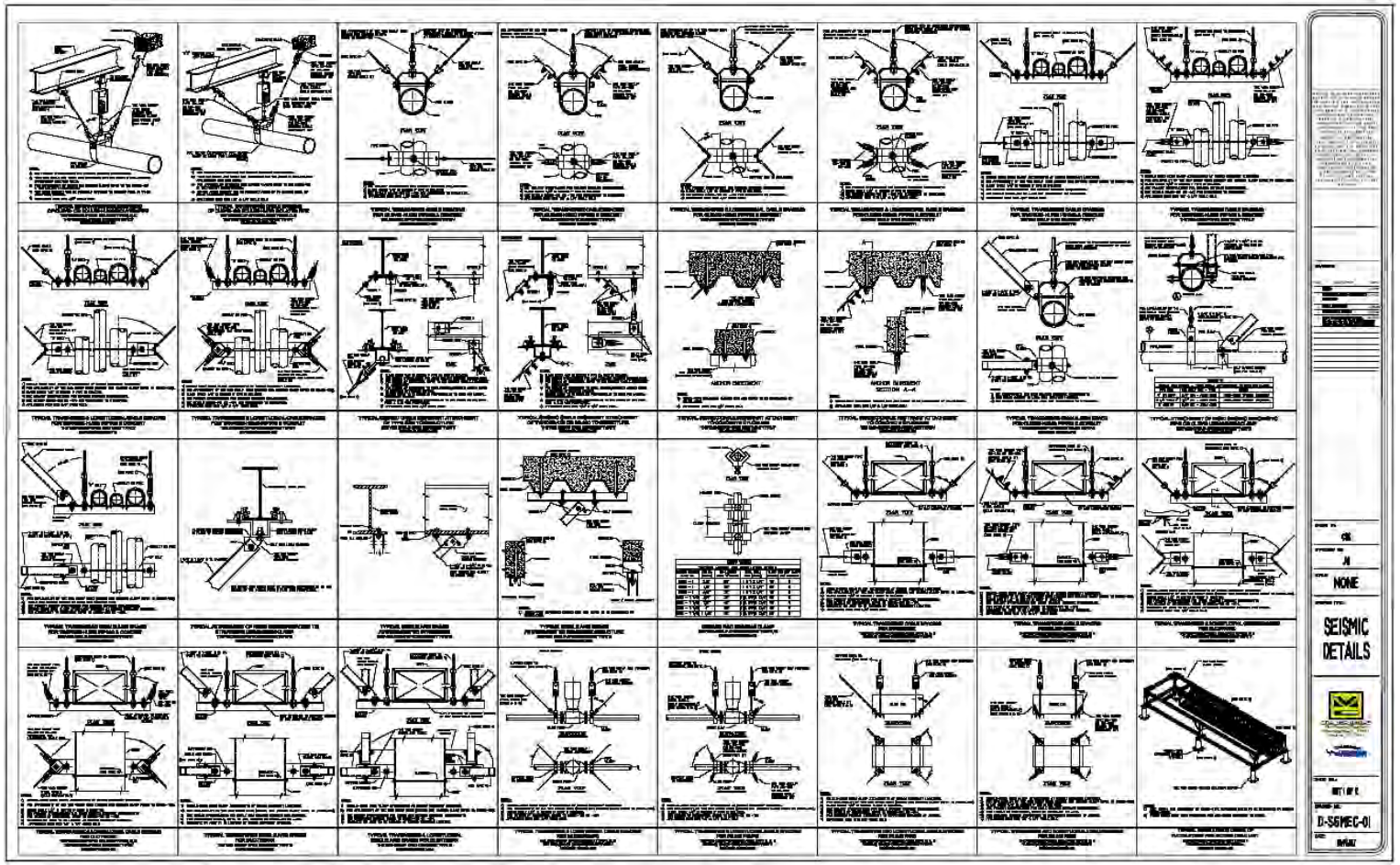
B. The work in this section includes, but is not limited to the following:

1. Vibration isolation for piping, ductwork, conduit and equipment.
2. Equipment isolation bases.
3. Seismic restraints for isolated equipment.
4. Seismic restraints for non-isolated equipment.

REQUIREMENTS

# SGMEC PROJECT MANAGEMENT PLAN



REQUIREMENTS

# SGMEC PROJECT MANAGEMENT PLAN

- Project Inception Questionnaire
  - Occupancy Category
  - Soil Site Class (Seismic)
  - Wind Speed
  - Flood Area
  - Seismic Design Category
- Let Them Know
  - In a letter to the architect and structural engineer indicate the impact that seismic, wind and flood (as it relates to MEP systems) will have on the building.

REQUIREMENTS

# SGMEC PROJECT MANAGEMENT PLAN

- Let's Get Together
  - 1st meeting should include everyone involved with design.
  - 2nd meeting should include everyone involved with construction.
  - Don't forget the building official or AHJ.
- Let the Vendors Know
  - Put all equipment suppliers on notice that certified equipment is a requirement for the project.
  - Don't just rely on the specifications to make the announcement.

REQUIREMENTS

# SGMEC PROJECT MANAGEMENT PLAN

- The Design
  - After receiving the design questionnaire back, review your design to ensure it meets the requirements of the code.
  - Have all critical components and systems been identified?
  - Have you addressed seismic, flood and wind?
- The Drawings
  - Make them clear – this is one of the biggest exposures to risk.
  - Clearly state the code of design for the project.
  - Have specific seismic, wind and flood detail sheets.
  - If there are crossovers between trades, be sure to include their details on your drawings.
  - Use the SGMEC detail drawing in every bid package.
  - Clearly identify special inspections that are required.

REQUIREMENTS

# SGMEC PROJECT MANAGEMENT PLAN

- The Specification
  - Minimize conflicting stories with a well written spec in a central location in the bid package.
  - Use the SGMEC specification covering all disciplines.
  - Clearly state those components that require special seismic or wind certification and what those requirements are.
  - Clearly show the site specific requirements for the project (from the structural engineer's notes).

- Special Inspections and Quality Assurance
  - Define what you want and from whom on your drawings.
  - Chapter 17 of the code outlines the equipment and systems requiring inspection (1705).

# SGMEC PROJECT MANAGEMENT PLAN

- The Review
  - The contractor's written statement of responsibility should be reviewed and accepted (Section 1706).
  - Design team should approve the statement of responsibility prior to work commencing.
  - Use forms in the SGMEC program to manage the review process.

- Contractor Vendor Certification Form
  - Know ahead of time whether equipment being supplied meets the code.
  - Minimize delays and your liability by having the contractor supply you with Form CVC-1 from the SGMEC program.

REQUIREMENTS

# SGMEC PROJECT MANAGEMENT PLAN

- The Shop Drawing Review
  - Review of manufacturer's certificate of compliance.
  - Solicit copy of certification report from independent approved agency.
  - Request copy of label that will be affixed to equipment to demonstrate code compliance.

- Field Inspection (If in Your Scope)
  - Make sure components are properly labeled.
  - Follow the contractor prepared Quality Assurance Program that you previously approved.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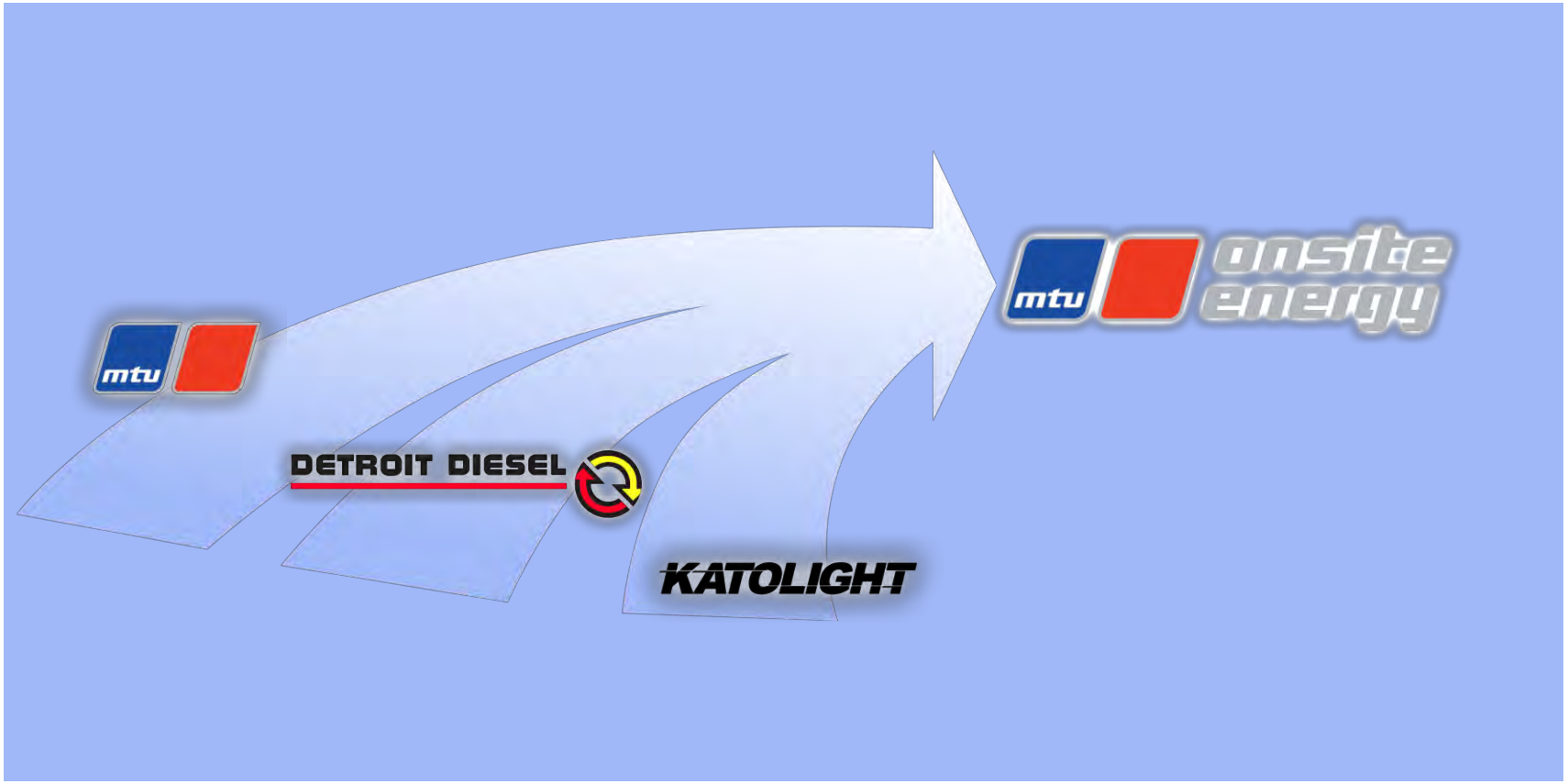
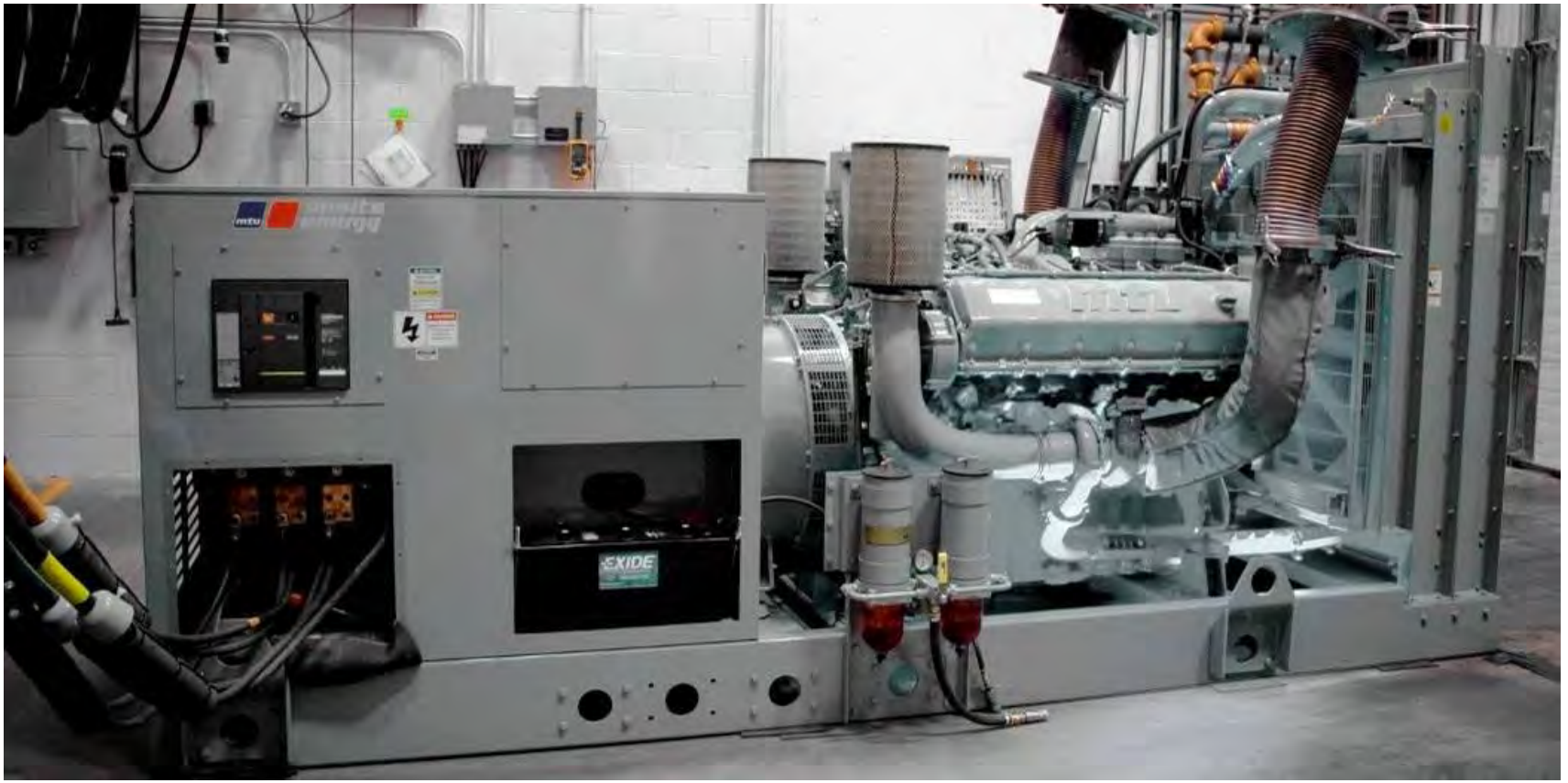
# A 100-YEAR
# LEGACY



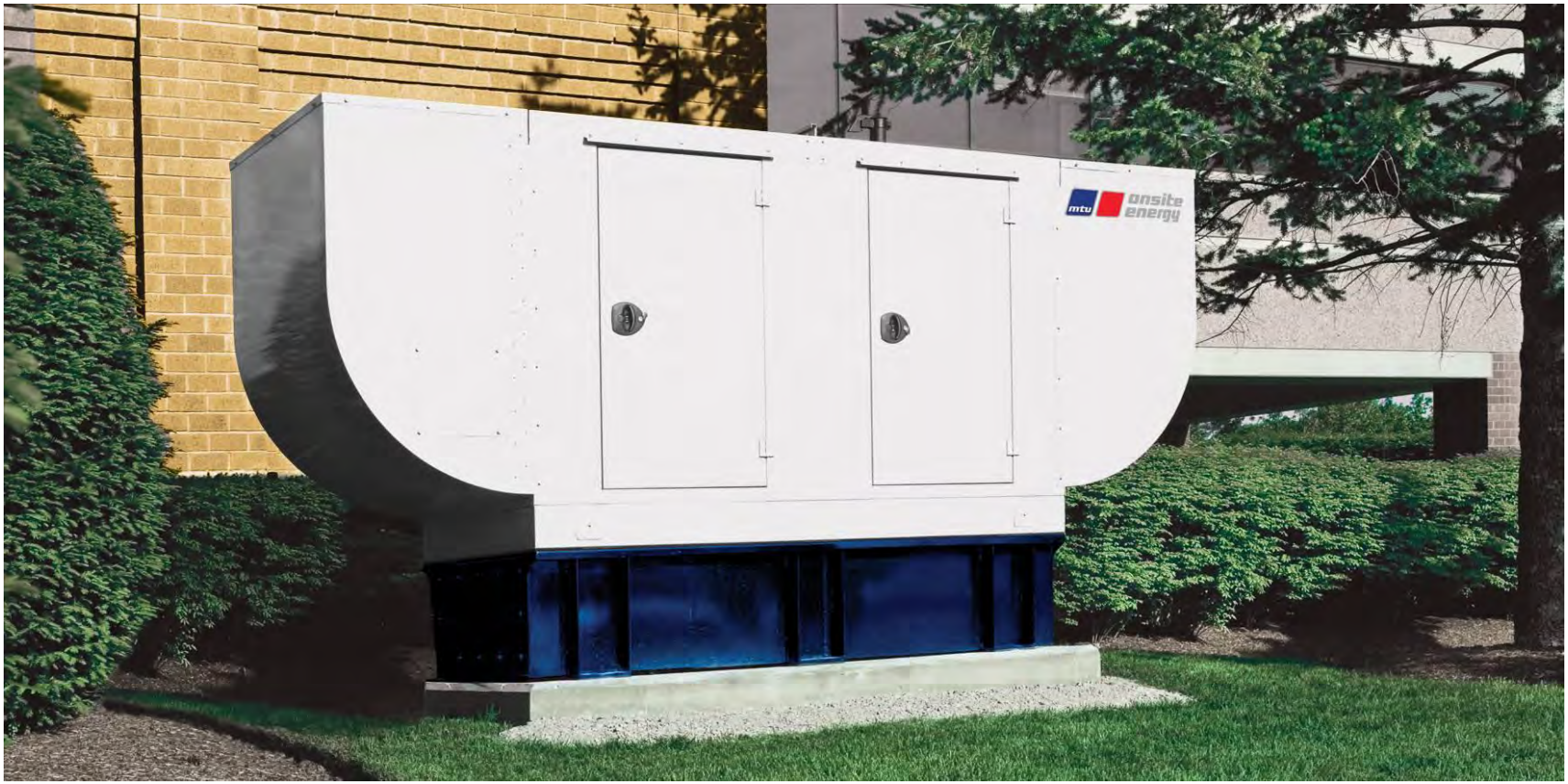



mtu onsite energy

# MTU SERIES 1600
## 270 kW - 635 kW



# RELIABILITY
## FOR YOUR NEXT PROJECT



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